CIRCUITOS RL E RC

DETERMINAÇÃO DAS CONDIÇÕES INICIAIS

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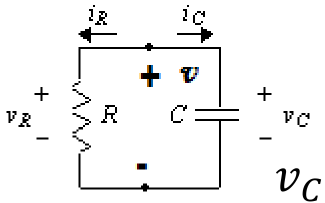
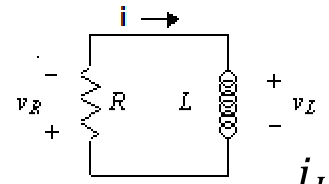
Fevereiro/2022

➢ Resposta Natural ou Transitória – Circuitos de 1ª. Ordem – RC ou RL



$$v_C(t_o) = V_o$$

(a)



$$i_L(t_o) = I_o$$

(b)

$$i_R + i_c = 0$$

$$\frac{v}{R} + C\frac{dv}{dt} = 0$$

$$v = V_o e^{-t/\tau}$$

Constante de Tempo

$$\tau = R.C$$

$$v_R + v_L = 0$$

$$R.i + L\frac{di_L}{dt} = 0$$

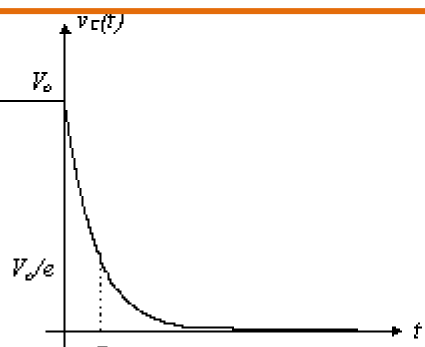
$$i = I_o e^{-t/\tau}$$

Constante de Tempo

$$\tau = \frac{L}{R}$$

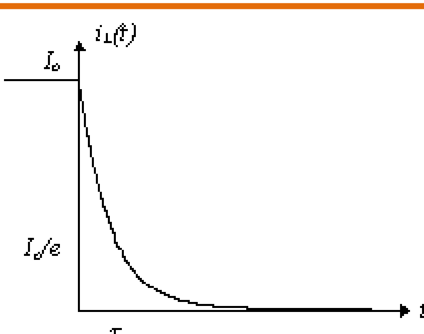
Em geral, para se determinar a constante de tempo há que se determinar a resistência equivalente visto por C ou L, ou seja, R_{Th} visto pelo terminais de C ou L.

Estado inicial



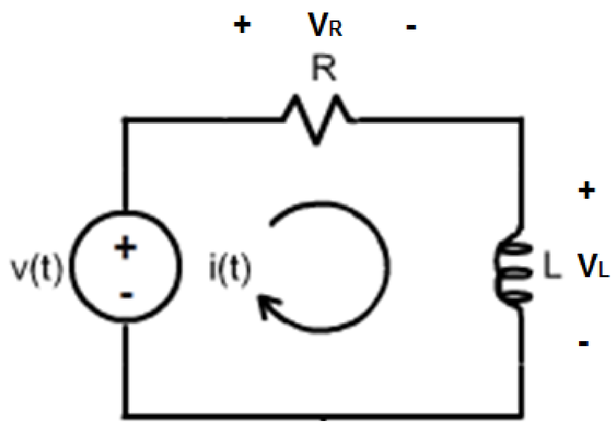
Estado final

Estado inicial



Estado final

- Resposta Completa – Circuitos de 1ª. Ordem – RC ou RL



$$R.i + L\frac{di_L}{dt} = v(t)$$

Equação diferencial de primeira ordem não homogênea

$$i_L(t_o) = I_o$$

Solução: resposta forçada + resposta natural

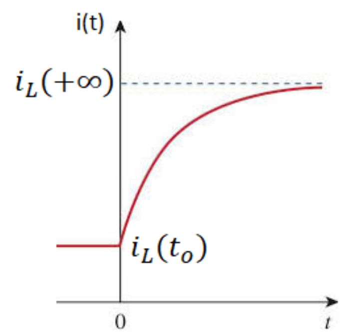
$$i_L = i_f + i_n$$

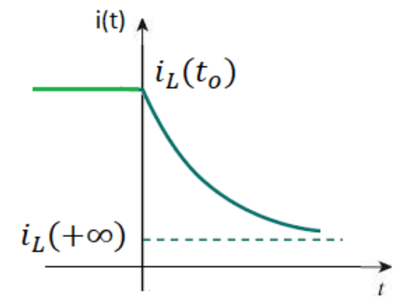
$$i_f \Rightarrow \quad depende\ da\ natureza\ da\ fonte$$

$$i_n \Rightarrow \quad i = Ae^{-t/\tau}$$

Para determinar $\boldsymbol{i_f}$ assume-se que a fonte esteja há muito tempo ligada no circuito, ou seja, que t→∞. Então:

$$i_L = i_L(\infty) + Ae^{-t/\tau}$$



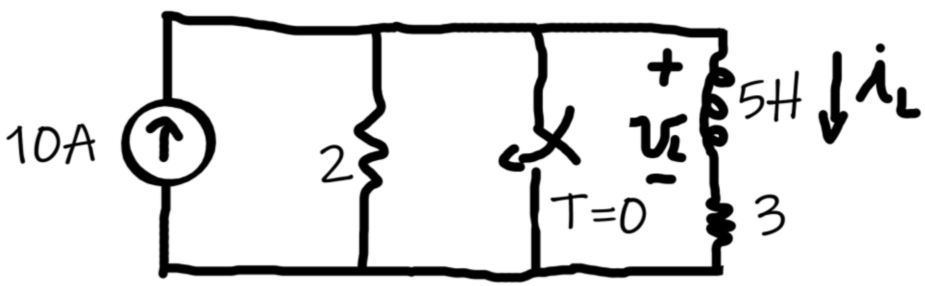


Para determinar a constante A, utiliza-se a condição inicial da corrente no indutor, ou seja, i_L(to). Então:

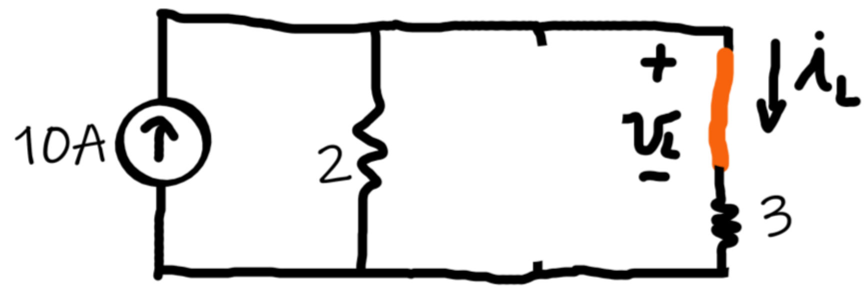
1

$$i_L(t_0) = i_L(\infty) + Ae^{0/\tau} \Rightarrow \boxed{i_L(t_0) = i_L(\infty) + A}$$

Exemplo 1: SADIKU 7.7 - Revisão

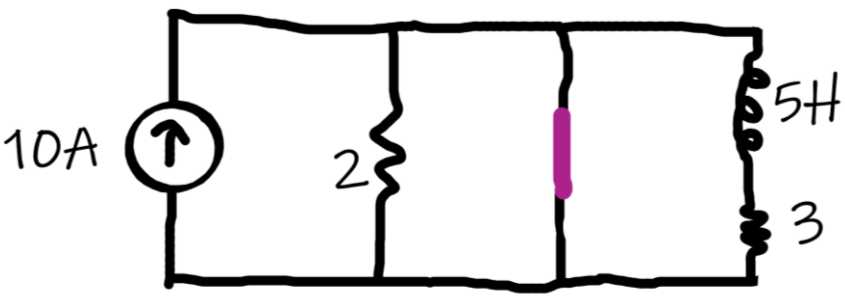


t<0s



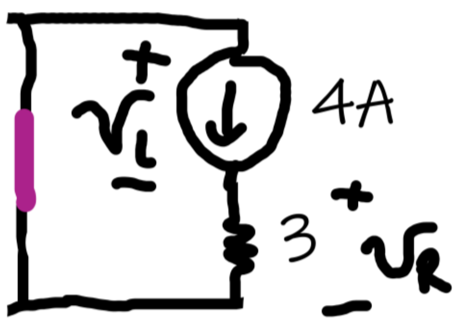
$t = 0^-$ $\quad i_L(0^-) = \dfrac{2}{2+3}.10 = 4A \quad v_L(0^-) = 0V$

t>0s



$$i_L(0^-) = i_L(0) = i_L(0^+) = 4A$$

$t = 0^+$



$v_R(0^+) = 3.4 = 12V$

$v_L(0^+) + v_R(0^+) = 0$

$v_L(0^+) = -v_R(0^+)$

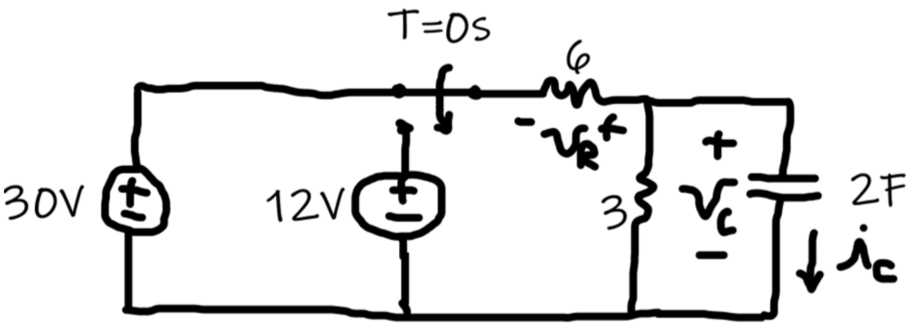
$v_L(0^+) = -12V$

$t \to +\infty$

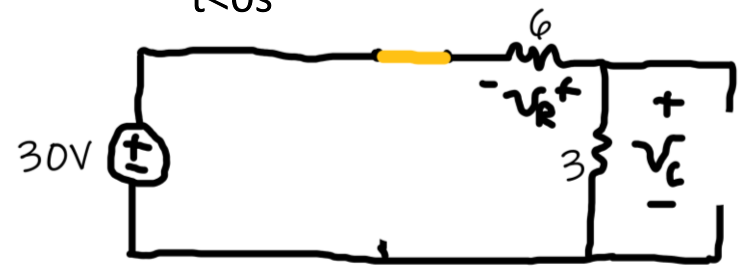
$i_L(+\infty) = 0$A

$v_L(+\infty) = 0V$

Exemplo 2: SADIKU 7.36

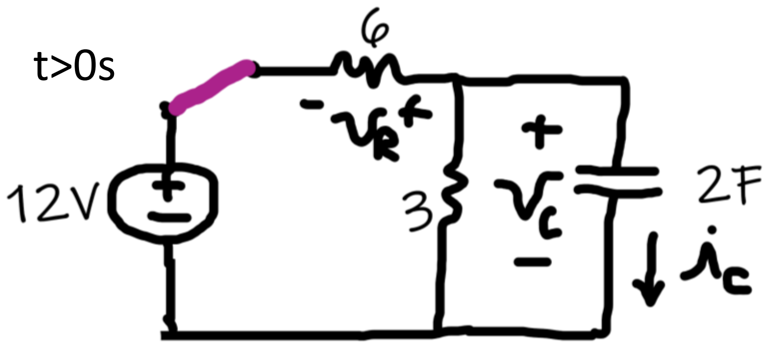


t<0s



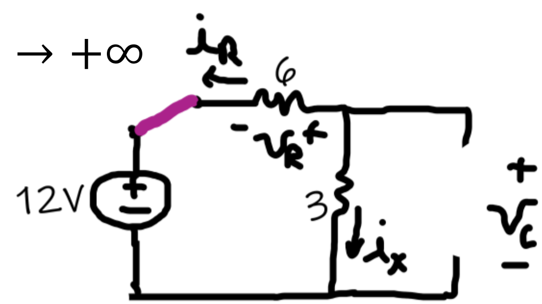
$t = 0^-$ $\quad v_C(0^-) = \frac{3}{6+3}.30 = 10V$ $\quad v_R(0^-) = -\frac{6}{6+3}.30 = -20V$ $\quad i_C(0^-) = 0A$

t>0s

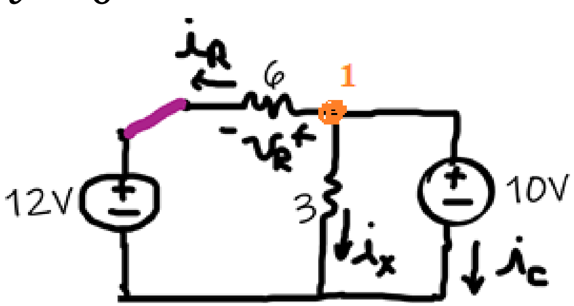


$$v_C(0^-) = v_C(0) = v_C(0^+) = 10V$$

$t \rightarrow +\infty$



$t = 0^+$



$$v_R(0^+) = 10 - 12 = -2V$$

$$i_R(0^+) = -\frac{2}{6} = -\frac{1}{3} = -333{,}33mA$$

$$i_X(0^+) = \frac{10}{3} = 3{,}33A$$

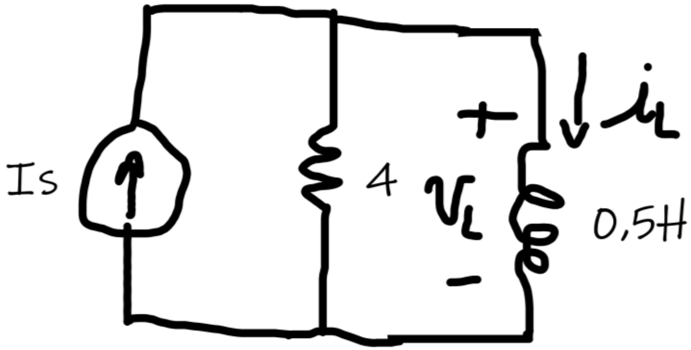
$$Nó\ 1 \Rightarrow \quad i_C + i_R + i_X = 0$$

$$i_C(0^+) = -\left(-\frac{1}{3}\right) - \frac{10}{3} = -3A$$

$$v_C(+\infty) = \frac{3}{6+3}.12 = 4V$$

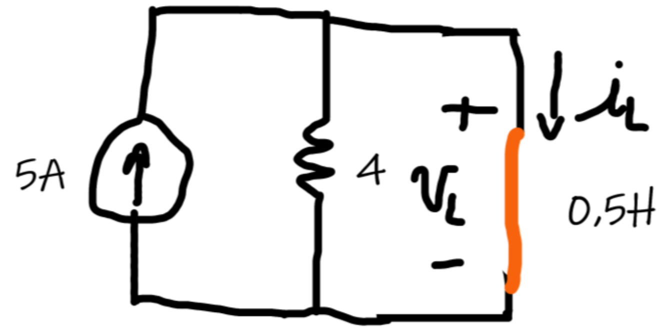
$$v_R(+\infty) = -\frac{6}{6+3}.12 = -8V$$

Exemplo 2: SADIKU 7.52



Is = 5u(-t)+15u(t) [A]

t<0s

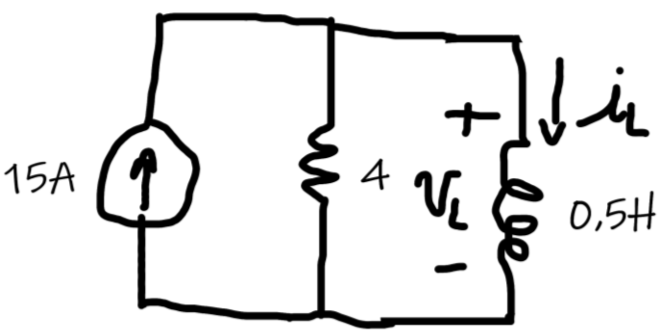


$t = 0^-$

$i_L(0^-) = 5A$

$v_L(0^-) = 0V$

t>0s

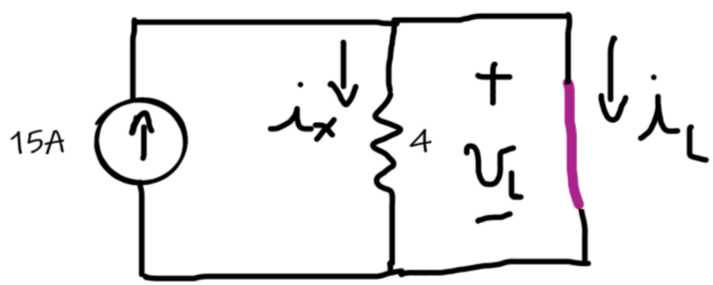


$t = 0^+$

$i_x(0^+) = 15 - 5 = 10A$

$v_L(0^+) = 4.10 = 40V$

$t \to +\infty$



$i_L(+\infty) = 15A$

$v_L(+\infty) = 0V$